



5th International Seminar on Underground Space
Health & Safety in Underground Space
October 18th, 2019, Lisboa, Portugal

ACTIVE PROTECTION IN FIRE FIGHTING FIRE FIGHTING PUMPING SYSTEMS

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FGU Fachgruppe für Untertagbau
GTS Groupe spécialisé pour les travaux souterrains
GLS Gruppo specializzato per lavori in sotterraneo
STS Swiss Tunnelling Society

SUMMARY

- > 1. Applications
- > 2. Standards
- > 3. Fire Pump Design
- > 4. System Engineering
- > 5. Testing
- > 6. Installation & Commissioning
- > 7. Maintenance



1. APPLICATIONS

- > Hose Reel Systems – 1st Intervention
- > Hydrants – 2nd Intervention
- > Sprinklers – Immediate response
- > Water Curtains
- > ...



1. APPLICATIONS

- > Underground parking lots
- > Tunnels
- > Underground power plants
- > Subway stations
- > ...

For tunnels, the main purpose is to control the fire and keep ambient temperature as low as possible, until other means of fire protection arrive!

2. STANDARDS

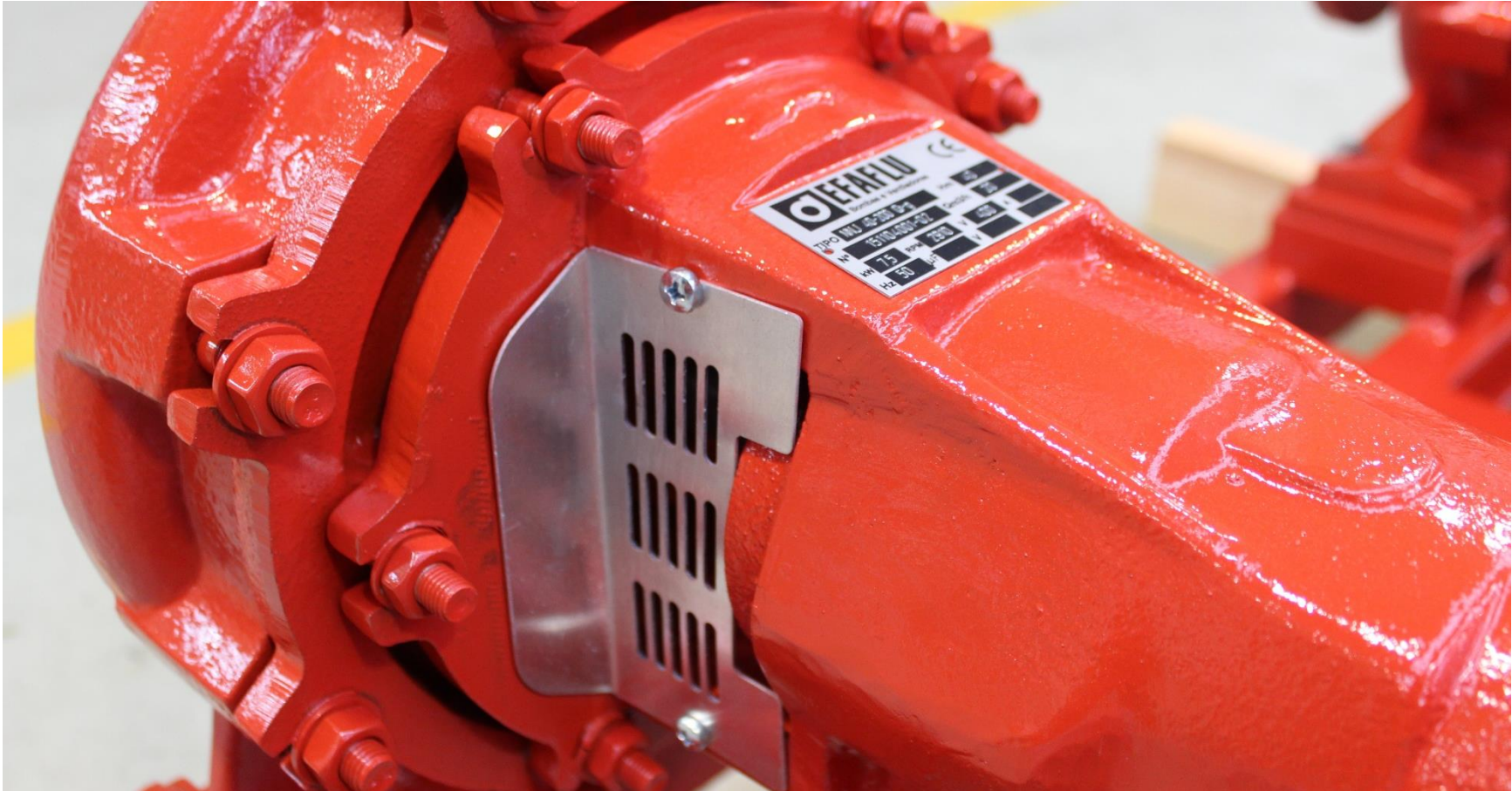
- > EN 12845:2015
- > ANPC 14903/2013 – Nota Técnica 15
- > ISO 9906 Gr 2B

- > EN 12259-12 (draft)
- > CEPREVEN
- > APSAD
- > NFPA20
- > LPCB

EN 12845



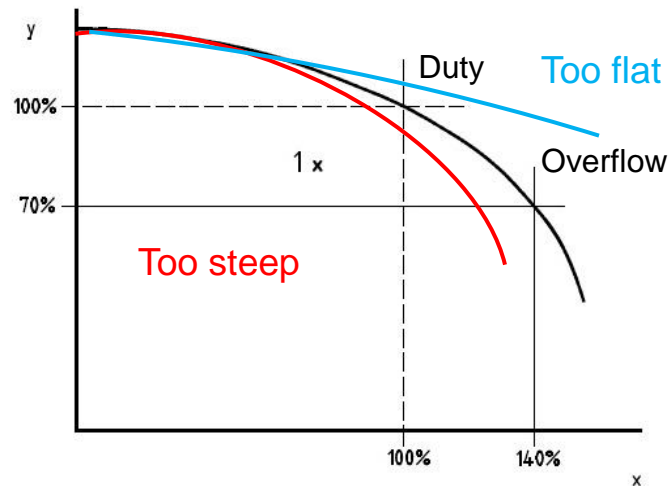
3. FIRE PUMP DESIGN



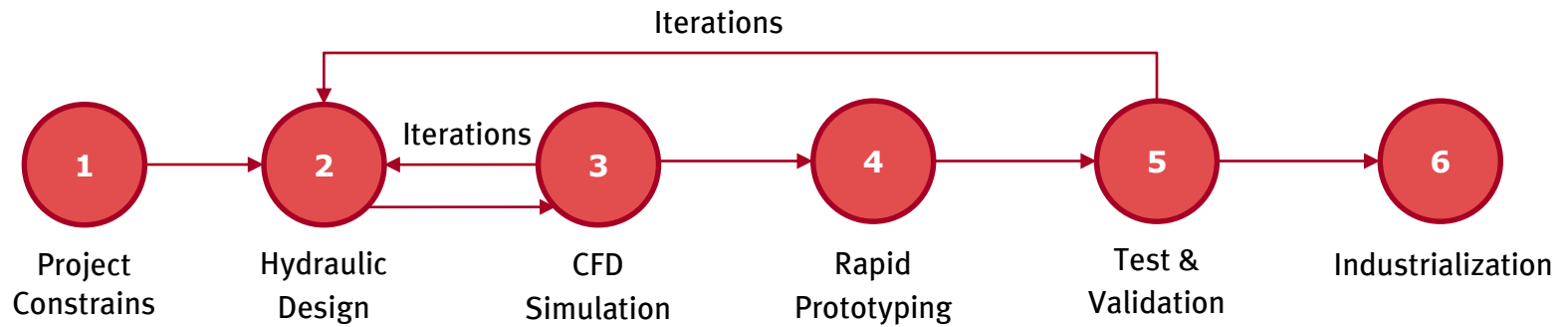
3. FIRE PUMP DESIGN

Hydraulic Design

- > Achieve requested duty point
- > Obtain a stable curve
- > Achieve overflow conditions
- > Higher efficiency – lower power consumption
- > Low required NPSH



3. FIRE PUMP DESIGN




3. FIRE PUMP DESIGN

Mechanical Design

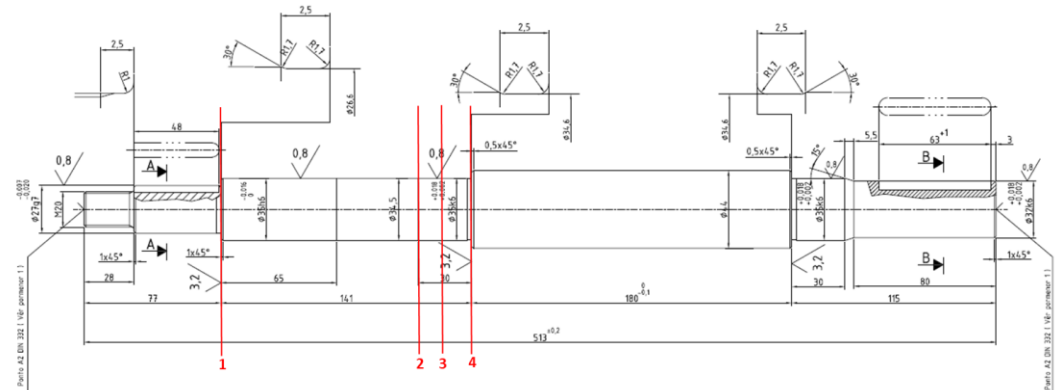
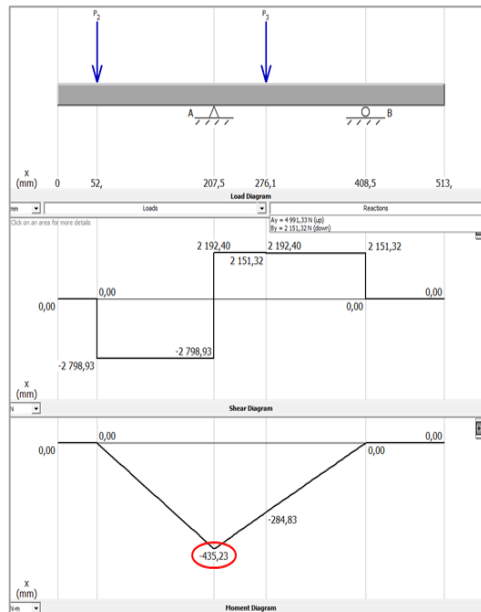
- > Long inactive periods
- > Startup at rated speed – 3000 rpm
- > Might operate at zero flow for prolonged periods



- 
- > Shaft deflection and fatigue
 - > High loads on bearings
 - > High shut-off pressure
 - > Corrosion
 - > Abrasion – high recirculation
 - > Overheating – high recirculation

3. FIRE PUMP DESIGN

- Shaft load analysis
- Fatigue calculation for shear and torsional stresses
- Bearing selection



	1	2	3	4
3S	4,15	2,26	4,00	2,13

3. FIRE PUMP DESIGN

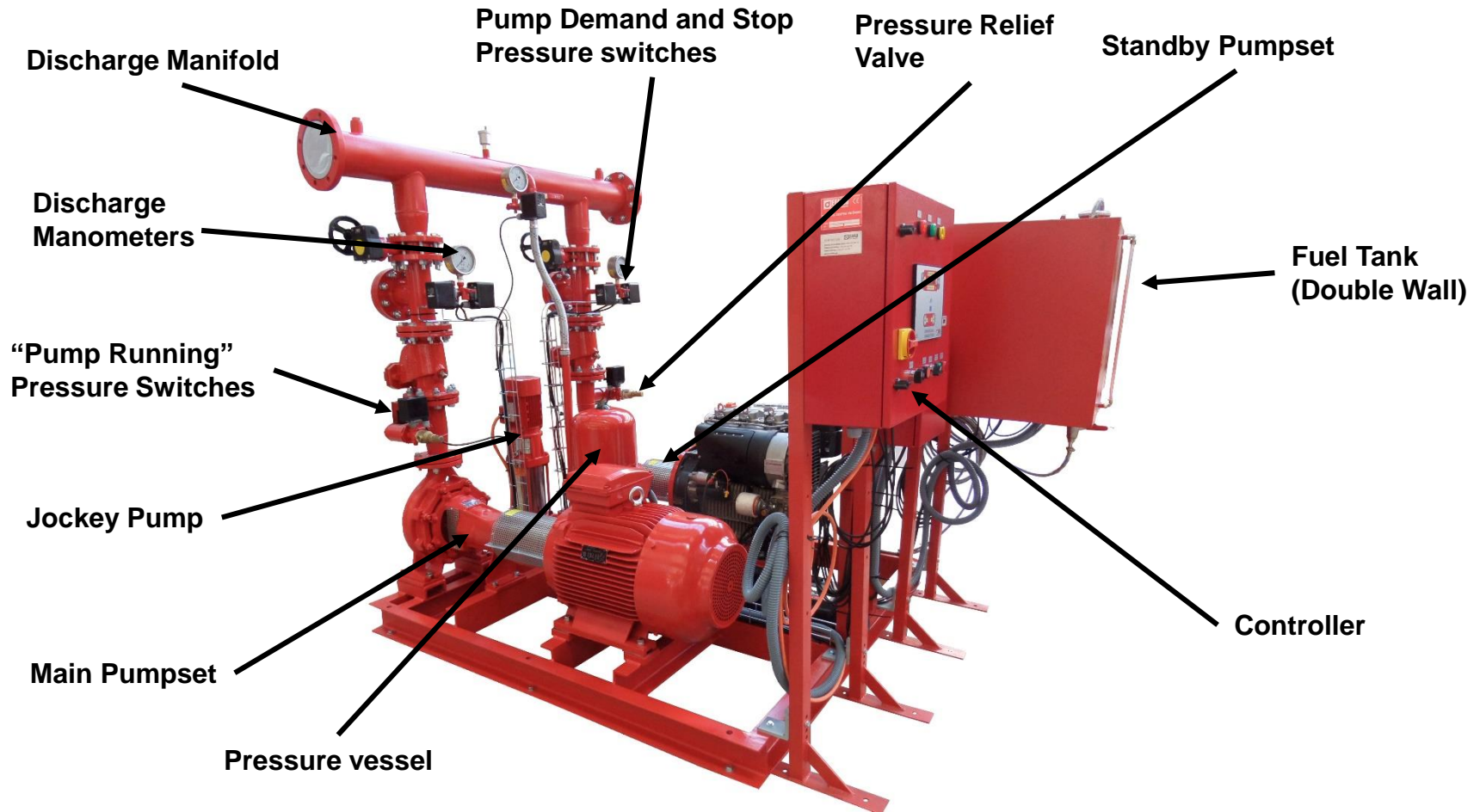
- Impellers in Zinc free Bronze or AISI316L
- Casings and wear rings in grey cast iron (GG25)
- Shaft and other metallic parts in suitable Stainless Steel
- Pump with back pull-out design
- Rotodynamic balancing according to ISO 1940 for vibration free operation



4. SYSTEM ENGINEERING



4. SYSTEM ENGINEERING



4. SYSTEM ENGINEERING

Configurations

- At least one main pumpset, one standby and one jockey (double set)
- If both are electric driven, main power supply may be public – directly from distribution transformer - but the standby power supply must be from a generator
- If both are diesel driven, each engine must have an independent fuel tank
- For double sets, each pump must deliver the requested duty point

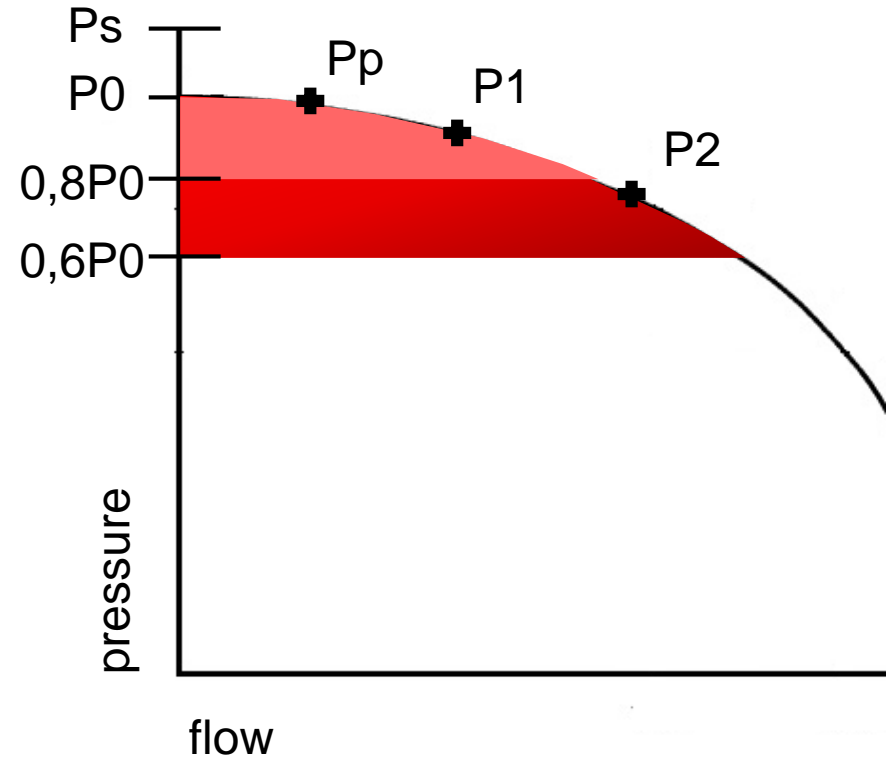


The fire fighting pump system must be exclusive for this purpose!

4. SYSTEM ENGINEERING

Type of operation

- > 0. $P_s > P_0$
- > 1. P_s drops
- > 2. Main startup order
 $P_s = P_1$
 $P_0 > P_s > 0,8P_0$
- > 3. $P_s = P_p$
- Or..
- > 4. $P_s < P_1$
- > 5. Standby startup order
 $P_s = P_2$
 $P_1 > P_s > 0,6P_0$



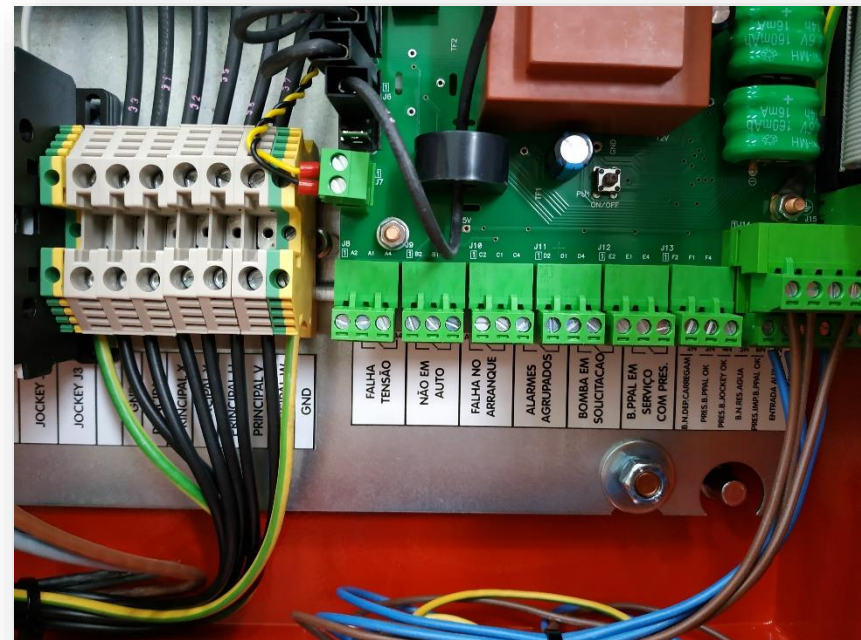
- > **MANUAL STOP** available after P_p is achieved

4. SYSTEM ENGINEERING

Controller

- Provides all the alarms and measurements for system control and monitoring
- Dry contacts to transfer alarms to SCADA systems

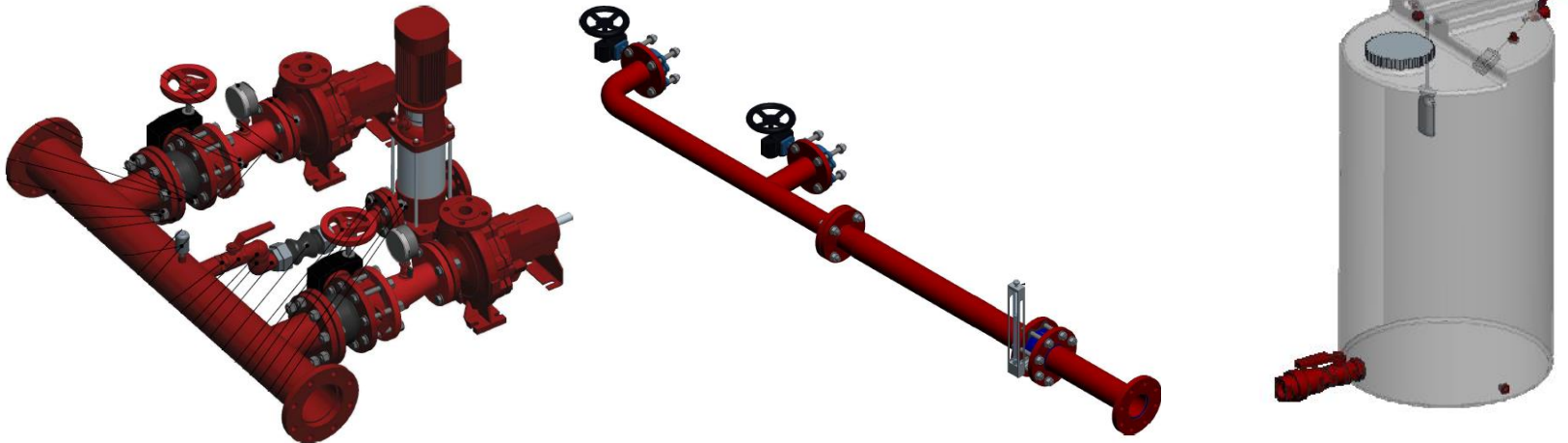
- Supply fault
- Manual mode
- Group alarm
- Faulty pump startup
- Pump demand
- Pump running



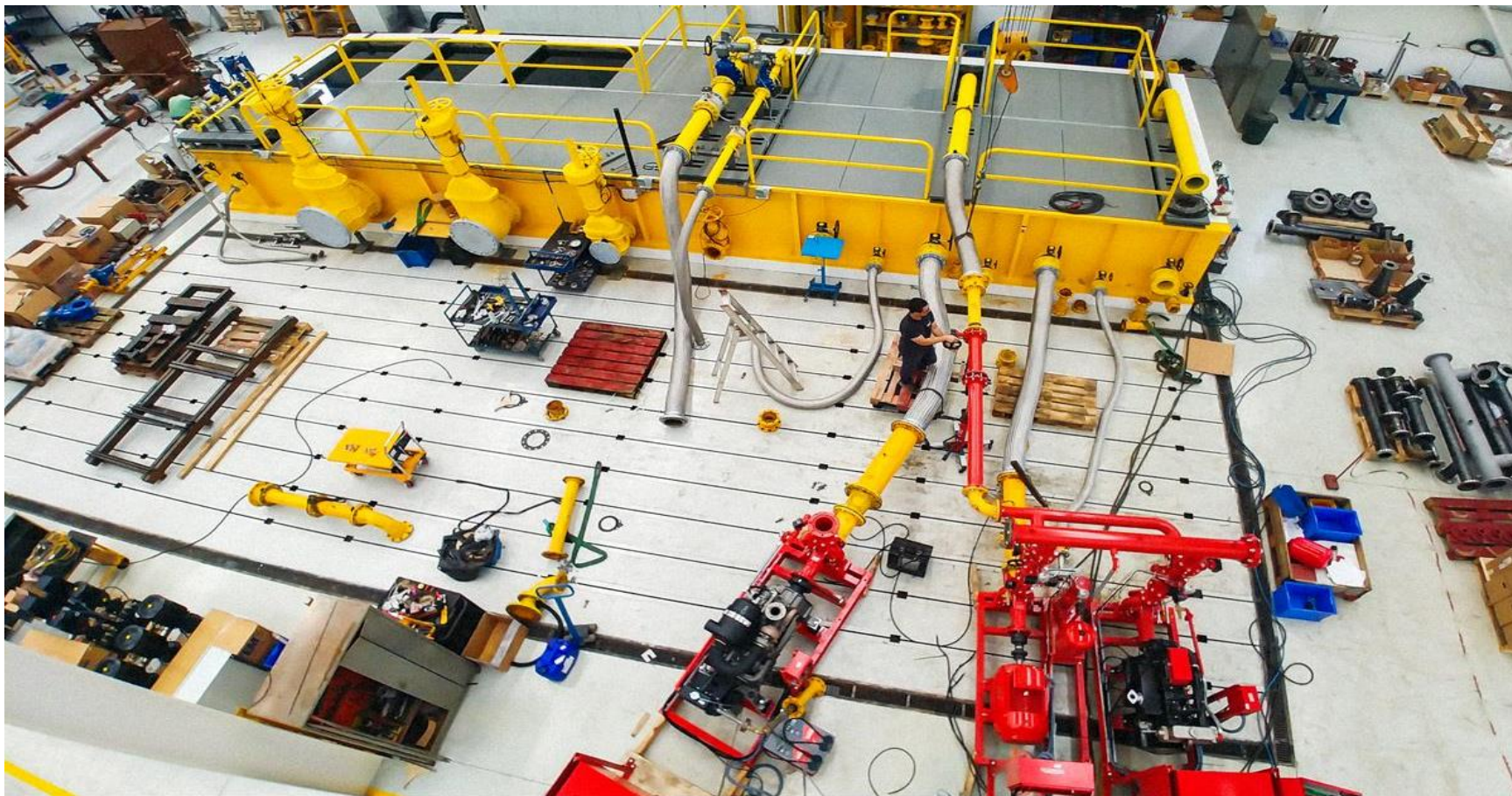
4. SYSTEM ENGINEERING

Other components

- > Inlet manifold – with eccentric cones, vacuum gauges and flexible joints
- > Flowmeter circuit for testing
- > Priming tank – for negative suction only



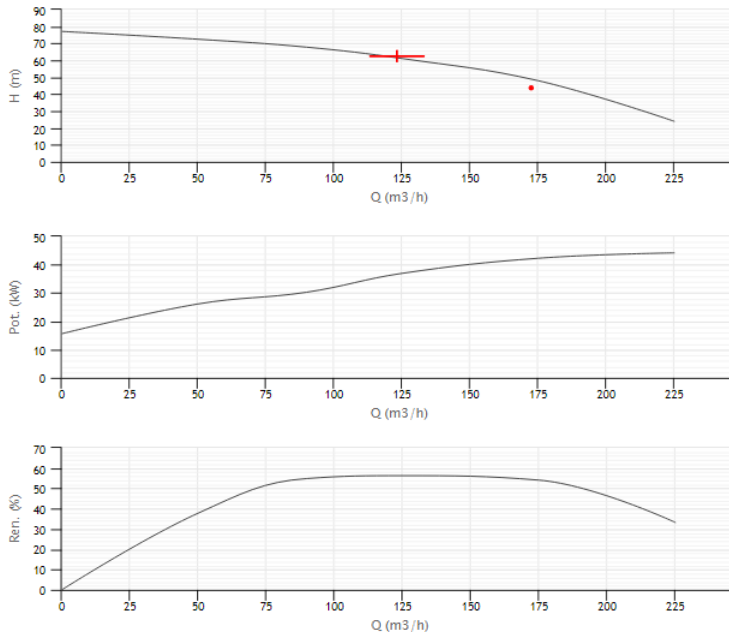
5. TESTING



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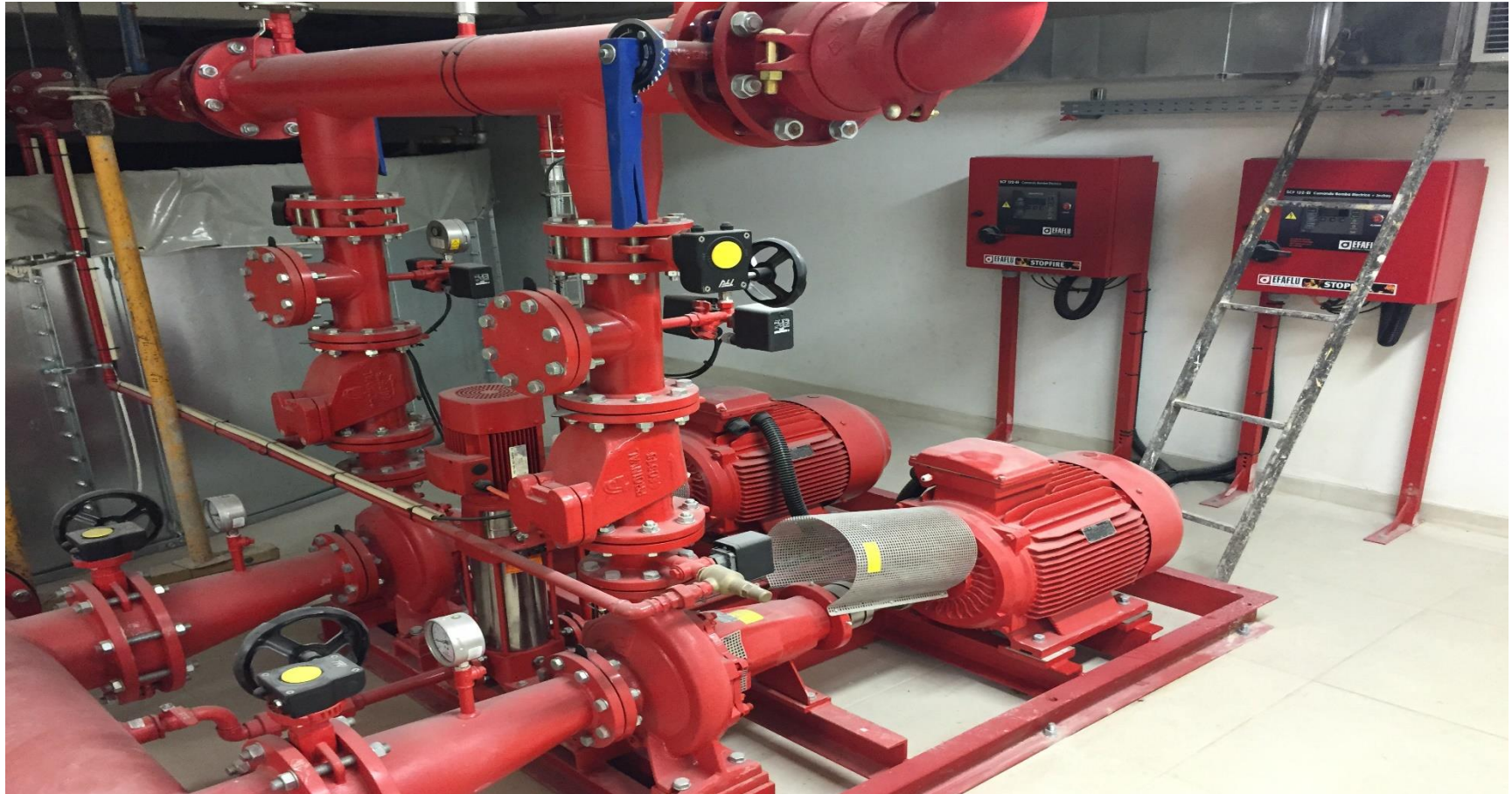
5. TESTING

- > Hydraulic performance according to ISO 9906 grade 2B – bilateral tolerance
- > Hydrostatic leakage test at 1,5 times maximum pressure
- > System automation – pressure switches, alarms, controller configuration, ...
- > **Full test report provided with each FFPS**



Ensaio	Validações	Observações
3.2.1 Verificar / Afinar Calibre Fusíveis / Magneto-Térmico	✓	
3.2.2 Teste de lâmpadas	✓	
3.2.3 Arranque e paragem Manual	✓	
3.2.4 Arranque por queda de pressão	✓	
3.2.5 Pressão de arranque	✓	E1: 6.9-5.6 bar
3.2.6 Sinal de bomba pedida	✓	
3.2.7 Arranque de emergência	○	
3.2.8 Temperatura de rolamentos	○	
3.2.9 Alarmes locais e à distância	✓	
3.2.10 Funcionamento c/ sinalização Falta de Água	✓	

6. INSTALLATION & COMMISSIONING

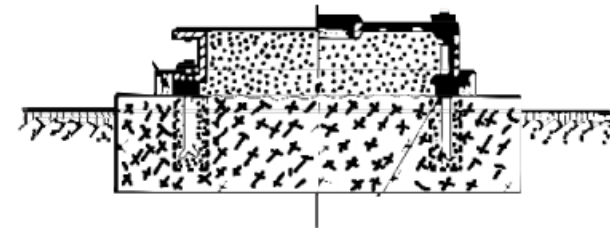
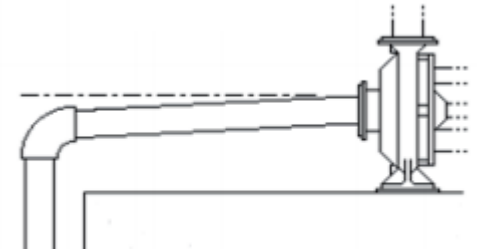
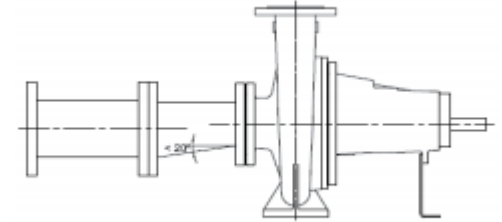


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6. INSTALLATION & COMMISSIONING

Installation

- > Pump housing shall be exclusive for this purpose, properly dimensioned and with good accessibility for operation and maintenance!
- > Proper fixation in a solid concrete base
- > Eccentric cones on inlet for optimum suction conditions
- > Ascending inlet piping to avoid air traps
- > Do not support piping on the equipment
- > Drainage hole to avoid deluge on pump housing



Details matter for system performance and lifetime

6. INSTALLATION & COMMISSIONING

Commissioning

- > System performance test onsite through:
 - Flowmeter circuit
 - Furthest hose reel

- > Lab tests are repeated onsite
- > Test report provided on-the-go

- > **Commissioning is the only guarantee that the FFFS can exactly behave as supposed in case of fire**

7. MAINTENANCE



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7. MAINTENANCE

- > Weekly startups performed by local maintenance team
- > Semiannual maintenance by specialized EFAFLU after sales technicians
- Global inspection
- Consumables replacement
- Full functionality tests
- Independent pumpset testing without compromising fire protection during that period
- > **Regular inspection and maintenance are key factors to assure fire protection – do not underestimate these**



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